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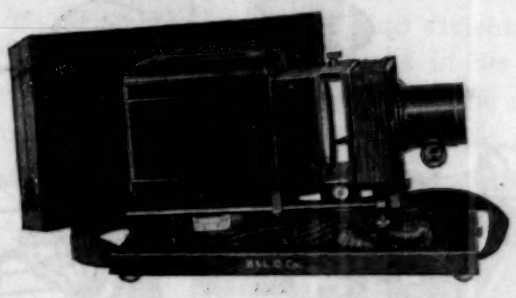

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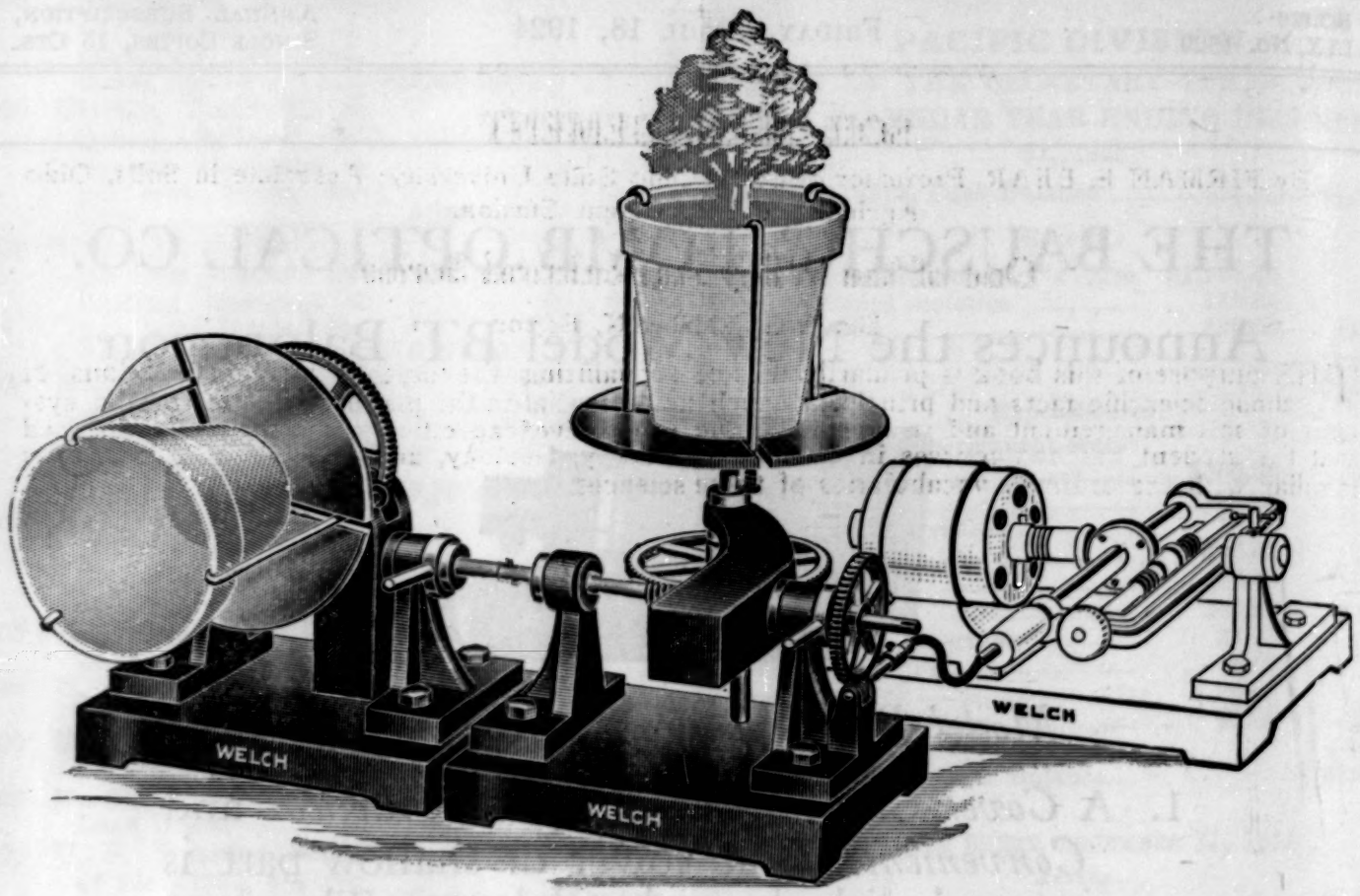

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SCIENCE

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THE CONTRIBUTIONS OF CHINA TO THE SCIENCE AND ART OF MEDICINE[1]

I. INTRODUCTION

FOR one who, from his medical infancy upwards, has been nourished on the teachings of Keen; who has paid homage to the personality and life of Weir Mitchell; who has seen Hobart Hare's writings translated into Oriental languages and has used them as text-books in his own classes; who has seen Chinese students become as devoted as those of Philadelphia to the radiating thought of Da Costa and others in the Jefferson faculty; for such a person to stand in the presence of a Jefferson audience and speak of a distant land might seem beside the mark, were it not that I rejoice to-day in this opportunity—especially since I have now become a son of Jefferson—to add my tribute of regard and gratitude to the teaching and life of the men on the great roll of honor of this college and to the wisdom and foresight of its trustees.

We are here to consider for a few minutes the essential unity, in development and maturity, of the medicine of the eastern and the western world. We do well to admit our indebtedness to a land that till recently had seemed an *ultima Thule* to many of us.

II. THE MEDICAL ANCESTRY OF OUR PRESENT CIVILIZATION

Will you travel with me to Peking, and make your way to the Forbidden City? There, in a temple within the precincts of the "Great Medical Court," we shall find gilded statues of three emperors, honored by all Chinese as the founders of their national system of medicine.

The two at our right are Shen Nung and Huang Ti. Even the simple-minded peasant knows that "Shen Nung sampled a hundred herbs." From the time he came to the throne (about B. C. 2737), we are told that he spent a portion of each day in tasting botanical specimens. No wonder he is acclaimed as "Father of Medicine"!

Next to Shen Nung is the seated figure of Huang Ti, who began to reign in B. C. 2696. How little he realized that the "Canon of Internal Medicine," which is attributed to him, would become the final medical authority for China's four hundred millions for four thousand years.

[1] Commencement address at Jefferson Medical College, Philadelphia, June 1, 1923.

To the left, more completely apparelled, sits Fu Hsi, the inventor of clothing and the discoverer of the trigrams used in later years by Taoist soothsayers. Legend tells us that he was riding on the back of a dragon-horse that rose from the waters of the Yellow River—the date being given as B. C. 2852—when the intricate system was revealed to him. There are others, too, whom fame has crowned. Let me bring you to Central China where, hanging in the corridors of a modern hospital at Changsha, we shall find black and gold lacquered tablets, the gifts of grateful patients. On one of these, in great gold letters, is the inscription, "Ming Kao Ho Huan"—"A name as great as that of Ho or Huan." Accustomed as we of the west are to trace our civilization to a Mediterranean ancestry, or as physicians to think of Greek medicine as at the very beginning of the era of honest observation, have we ever stopped to think that China, too, must have had its outstanding figures, representatives in that eastern world of the highest ideals of medicine? Ho and Huan are legendary names, to be sure, but their teaching has lasted through countless generations. They are the Hippocrates and Galen of eastern Asia, and we of the west who come to practice in China are compared, for better or worse, with them!

Would that we might discover the link between eastern Asia and eastern Europe! Did Ho and Huan send their knowledge of the healing art across by some camel train through Mongolia and over the plains of Central Asia to the shores of the Aegean Sea? Did China and Greece have a common medical ancestry, or did their practice develop independently? The seeds of civilization, men say, were sown about B. C. 4000 by the Sumerians. Did religion and statecraft all spring from their home in central Asia, as well as pictorial writing, astronomy and the natural sciences?

We have, as yet, but little light on the unity of these early origins. They must be thoroughly studied. Meantime we may glance for a moment at the similarities between Greek and Chinese philosophy in the realm of medicine. Again and again the words of Fuller prove true:

> This world affordeth no new accidents, but in the same sense wherein we call it a *new moon*, which is the old one in another shape; and yet no other than that hath been formerly. Old actions return again, furbished over with some new and different circumstances.

How alike these ancients were in their thought that the elements in the macrocosm—the world at large—found their counterpart in the microcosm—the world of man's body! Empedocles taught that the four elements, fire, air, earth and water, were "the roots of all things." Chinese philosophers, long before him, delineated a macrocosm made up of five elements, metal, wood, water, fire and earth. Like the outer world, they said, the human body, too, is made up of five elements. So long as these elements remain in harmonious proportion, there is health; if the balance is disturbed, disease follows.

The mysticism of the figure five extends further still. Corresponding with the five elements are the five organs—spleen, liver, heart, lungs, kidneys, all of which are interrelated with a complex system including planets, colors, tastes and types of weather.

Thus, the heart is in the same series as the planet Mars, as fire, as the color red, as bitter, as heat, as south, etc.

As you read the "Canon of Medicine" or the "Medical Secrets of an Official," and note universal belief in a body full of channels through which spiritual influences flow, and where heat and cold, dampness and drought, course freely, you feel that these men must be prototypes of the Greek leaders of medical science.

III. The Sources of Our Knowledge about Chinese Medicine

There are several important sources from which we can learn about Chinese medicine.

In the first place, every family knows about the principles of physiology and of treatment laid down as long ago as B. C. 1000. As a result, the physician summoned to-day to prescribe for a patient is really appearing before a jury. He must satisfy the family that he can use accepted methods of studying the case; that he can explain the nature of the malady in orthodox terminology. He must gain their assent to his diagnosis, before he is allowed to "open the prescription" which is the objective of every physician's visit. Whether he is sent for again depends on the progress of the disease after the patient has taken one or two doses of the medicine ordered. The family is in charge, not the physician. It is they who try the physician; and make or break his reputation.

A second source is in the archaic forms of the Chinese ideographs. The ancient character for doctor was composed of three parts. At the top was a quiver containing arrows, and beside it a spear, while below was the character for a sorcerer (male or female). Thus the sorcerer was supposed to expel disease by the aid of his magic spear and arrows. Later on the lower radical was changed to the character for wine, suggesting that a transition had occurred. The profession was thus seen to be passing into the hands of trained men who fought disease, not with magic, but with elixirs or wines.

Still a third source is in the dynastic histories. Thus the records of the distinguished contributors to medical science, and of government regulations re-

garding the practice of medicine, appear in general histories rather than in medical annals.

The medical classics themselves are a most prolific source of material. Preeminent among these is the "Nei Ching" or "Canon of Internal Medicine," said to have been written by the Emperor Huang Ti, B. C. 2696, but probably composed as late as B. C. 1000. Dr. Wong writes:

> What the Four Books are to the Confucianists, the Nei Ching is to the native doctor. Upon it is built most of the medical literature of China and so important is it considered by medical men that even at the present time, three thousand years after it was written, it is still regarded as the greatest authority.

IV. The Supernatural in Chinese Medicine

(1) *Animism:* Earliest of all Chinese theories was the belief in a universal animism, all parts of the universe being animated by spirit.

> The universe was spontaneously created by the operation of its Tao or Eternal Principal; "composed of the two souls, the Yang and the Yin; the Yang represents light, warmth, production and life, as also the celestial sphere from which all those blessings emanate; the Yin is darkness, cold, death and the earth, which, unless animated by the Yang of heaven, is dark, cold, dead. The Yang and the Yin are divided into an infinite number of spirits, respectively good and bad, called Shen and Kwei; every man and every living being contains a shen and a kwei, infused at birth, and departing at death, to return to the Yang and the Yin. Thus man with his dualistic soul is a microcosmos, born from the macrocosmos spontaneously. Every object is animated, as well as the universe of which it is a part."
>
> In addition to charms and spells, there were certain famous poems which were repeated, one of which, by Han Yu of the T'ang epoch, had an extraordinary vogue. de Groot says that the "Ling" or magical power of this poem must have been enormous, seeing that its author was a powerful mandarin and also one of the loftiest intellects China has produced. In this poetic febrifuge, translated in full by De Groot, the demon of fever, potent chiefly in the autumn, is admonished to begone to the clear and limpid waters of the deep river.

To the ordinary observer animism is seen as the religion of the overwhelming majority of the Chinese. The Tai Shan stone put up facing the exit of every little street or alley in cities, undertaking to keep evil spirits from the house in front of which it stands; the evening worship, when boys come out from the recesses of the shops on every street, to burn incense and make obeisance in the presence of the spirits; the cannon on the city wall, once able to put an enemy to flight and now the abode of a potent spirit; these and many others are symbolic of a prevalent animism.

(2) *Magic and exorcism:* Not far removed is the belief in magic and in exorcism. These seem, in the first place, to have been brought in by Taoists as a method of combating the influence of rival religions. It is scarcely conceivable that the spiritual teaching of Laotze, who lived some six centuries B. C., could have become so degraded with the passage of time. Compare this extract from the Tao Teh King—"Why was it that the men of old esteemed this Tao so highly, Is it not because it may be daily sought and found, and can remit the sins of the guilty?"—with the ideas of spirit possession in later Taoism, each organ of the body being occupied by some animal spirit; in the lungs the spirit of a white tiger; in the gall bladder a turtle and snake.

During the T'ang dynasty (628–907 A. D.) the search for the philosopher's stone and for the elixir of life reached its height. Magicians, doctors, alchemists, were alike experimenting with herbs and minerals. Of twenty-two rulers during this period seven experimented with elixirs and died from the effects; while the time, health and fortunes of thousands were wasted. And yet, these superstitious experiments brought us much knowledge regarding the action of many vegetable and mineral remedies.

Buddhism, similarly, brought to China by the Emperor Ming Ti (A. D. 68) started out as a religion of asceticism and genuine self-repression; and yet when its monks saw the devices used by the Taoists, they, too, invented their own systems of charms, and added to the popular burden of superstition. We occasionally find the influence of Buddhism in anatomical charts.

V. The Progress of Medicine in China after 250 B. C.

(1) *Before the Han Dynasty.* Again we are standing in the hospital corridor! Our attention is called to a particularly handsome lacquered tablet presented by Governor T'ang, bearing the inscription "Tao Kuang Ch'ang-san"—"Teaching as broad as that of Ch'ang-san."

Could greater tribute be paid to the modern physician? Was not Ch'ang-san the teacher of Pien Chiao, the most eminent of China's historic medical men, father of narcosis, distinguished teacher of sphygmology, practitioner among kings? We have left entirely the age of legend and have reached the period of dependable records by B. C. 722. Literature and art flourished. Never before had so many men of genius appeared within one short period. Laotze, Confucius, Mencius and many other philosophers of note lived at this time. And yet, in the field of medicine, men were already turning away from sound observation to develop theoretical knowledge. Authority was reverenced more than observation, and speculation became universal.

Pien Chiao lived about 255 B. C. It is told that he was asked to treat King Wu, of the state of Lu, and Tsi Ying, of Chao.

Pien Chiao gave them a narcotic wine to drink which made them unconscious for three days. He opened their chests, removed their hearts, exchanged them and put them in again under the administration of some effective drugs. When they awoke, they felt as before, took leave and returned home.

(2) *In the Han Dynasty and after.* Chinese medicine proper received its greatest impulse during the Han dynasty (220 B. C.–206 A. D.), largely through the work of Tsang Kung, Chang Chung-king and Hua To. I quote from Dr. K. M. Wong:

Tsang Kung, who lived about 170 B. C., was the first to record personal observations of clinical cases. In the biographical section of the Ancient History we find a detailed list of his case-histories from which we may have a peep into the medical thoughts of that time. Of the twenty-five cases he has left us—almost the only record of its kind for 1,500 years—ten are reported as fatal. Unlike Galen and most medical writers, Tsang Kung was more modest, for he admitted that his prognosis was not always accurate and that he could not cure any disease unless the pulse indications were favorable.

Chang Chung-king was mayor of Changsha about 196 A. D.

He is often spoken of as the Chinese Hippocrates and is venerated as the sage of medicine. His fame rests chiefly on his "Typhoid Fever," which is one of the medical classics ranking with Huang Ti's Canon of Medicine in importance, and was the first book of the kind in Chinese. This book does not, as the name implies, deal with typhoid only but with other fevers as well. In it are found 113 prescriptions. These were scientifically written containing only a few potent drugs instead of the later "shot-gun" practice of one or two dozen inert ingredients. The antipyretic treatment of fever by cold baths was described. This antedates James Currie's method by 1,700 years. Chang Chung-king was perhaps the first to employ the enema to evacuate the bowels.

After his time,

diseases were studied more from a clinical standpoint, emphasis being laid on the physical signs, symptoms and course of an illness, the methods of treatment and the action of drugs rather than on the theories of disease as in former times. Chang Chung-king stands above the crowd not only on account of his keen power of observation but also because of his lofty ideals. He gives to the profession a high conception of its dignity and noble mission in life. After his death scientific medicine may be said to have degenerated into dogmatic formalism. No writings of any value or originality appeared until the Sung dynasty, a gap of nearly one thousand years.

The third of this Han dynasty trio was Hua To, the most famous surgeon in China's history. It is said that he administered to his patients an effervescing powder in wine which produces complete unconsciousness and that he performed all sorts of operations ranging from venesection and acupuncture to laparotomy, excision of spleen, intestines and liver. A pioneer of hydrotherapy, he was also an exponent of systematic exercise. Most of the notables of that period were his patients. Among them was Kwan Kung, a famous general now deified as the god of war, on whom he operated without an anesthetic for a poisoned arrow-wound of the arm, excising the infected area. King Tso Tso was another of his patrons. Hua To offered to cure the king's headaches by opening the skull under hashish. This roused the royal anger and the surgeon was ordered executed. Just before death he asked the jailer to receive all his manuscripts, but the man was afraid, so Hua To burned them, nothing being recovered from the ashes but a few leaves on which were found directions for a method of castration, an operation still known to the Chinese and practiced frequently by them. In one of his last works, Hua To gives a prescription which is the earliest record of the use of mercury in internal medicine.

VI. Certain Definite Contributions Made by China

(1) *To the Science of Medicine.* We may now attempt to glean from the records those outstanding observations that have proved to be among the definite contributions made by the Chinese.

First, dissection. Because of the great reverence for the dead, human dissection was seldom attempted; hence gross mistakes are found in their conception of anatomy and physiology. The following two facts, however, are very little known and deserve mention. Dissection was evidently permitted in 2697 B. C. In the *Lin Shu* it is stated that after death the body may be dissected and observations made as to the size of the organs, the capacity of the intestines, the length of the blood vessel, etc. In the Han dynasty (220 B. C.–206 A. D.) Emperor Wang Mang captured a revolutionary and ordered his physician to dissect his body. Measurements were made of the internal organs and bamboo rods were inserted into the blood vessels to see where they began and ended.

Secondly, studies of the circulation. Hear these very significant passages, dated at least 1000 B. C.—more than 2,000 years before Harvey. They are taken from the "Canon of Medicine" already referred

All the blood is under the jurisdiction of the heart. . . . The twelve blood vessels are deeply hidden between the muscles and can not be seen. Only those on the outer ankles are visible because there is nothing to cover it in these places. All other blood vessels that are on the sur-

face of the body are "loh" vessels (veins). . . . The harmful effects of wind and rain enter the system first through the skin. It is then conveyed to the "sun" vessels (capillaries). When these are full it goes to the "loh" vessels (veins) and these in turn empty into the big "chin" vessels (arteries). . . . The blood current flows continuously in a circle and never stops.

Thirdly, the doctrine of the pulse. This reached such extraordinary development that the whole practice of the art centered round its different characters. There were scores of varieties, which in complication and detail put to confusion the complicated system of some of the old Graeco-Roman writers. The basic idea seems to have been that each part and organ had its own proper pulse, and just as in a stringed instrument each chord has its own tone, so in the human body, if the pulses were in harmony, it meant health; if there was discord, it meant disease.

Fourthly, systematic methods of physical diagnosis. No one can fail to be impressed with the care taken by the trained Chinese practitioner in carrying out the four orthodox steps in the examination: "Look, Listen, Ask, Feel." Each word is expanded to a chapter in the text-books. To look means training the eye to noting gait and posture, defect and discoloration. To listen signifies a detection of the meaning of abnormal sounds, such as dyspneic breathing; together with a recognition of many groans and grunts that the Chinese associate definitely with certain maladies. Every citizen and every physician interprets them correctly.

2. *To the Art of Medicine.* Several definite therapeutic methods practiced by the Chinese from time immemorial come to us to-day as their contribution.

Massage, for instance, has long been recognized. During the T'ang dynasty, 1,500 years ago, it was elevated to the position of a science, and formed one of the departments to which a special professor was appointed. It was finally brought to European notice for the first time in the 19th century by the reports of the Jesuit missionaries.

Acupuncture is a second established Chinese procedure. 367 points are described on the surface of the body, at which the insertion of a needle is supposed to afford outlet for harmful spirit influences. But while the dangers of infection and trauma are real, the physical benefits of its wise use are admitted. Acupuncture was carried to Japan, and thence to Europe by Ten-Rhyne, a Dutch surgeon, at the end of the seventeenth century. In France it had quite a vogue a century ago. British teachers, such as Sir James Cantlie, have tried it on sprains and chronic rheumatism and report successful cases.

Of antipyresis by cold baths, within the second century after Christ, mention has already been made.

The use of the catheter appears in China in the seventh century. First, hollow vegetable leaves and later, quills were used; though the method was not developed.

Inoculation against smallpox was practiced early, records being available of the transfer of virus from person to person in the seventh century, though the routine use of the method was not common until the eleventh. A century before Jenner, the standard materia medica mentions the use of cow fleas for the prevention of smallpox.

Organotherapy is described as early as the 6th century A. D., when sheep's thyroids were used for cretinism. The practice is familiar to house-wives throughout the land.

Perhaps the most extensive contributions are those dealing with materia medica. The "Synopsis of Ancient Herbals" published 300 years ago would delight the soul of Hobart Amory Hare. It took thirty years to prepare, and the author is reported to have consulted all the then known works. 1,892 distinct species are described and 71,000 formulae are provided for the budding practitioner. What an asset to the Jefferson Medical class of 1923 if its armamentarium could include such an array—surely weapons of attack for every known mortal ill.

Minerals were used even before the time of Christ. Thus the "Canon of Internal Medicine" describes arsenic and sulphur, copper and lead, in various forms, as established remedies. Mercury, both the red and yellow oxide, were used in ointments; calomel was well known.

VII. Conclusion

It is no longer true that east and west shall never meet! Jefferson Medical College has a distinguished array of graduates and teachers whose names are household words to the profession; but Jefferson's largest service will be found, in the future, as in the past, exemplified best by men who live the international life. Let a man like Victor Heiser be sent to the Philippines or to Siam or to China and you get more than health organization. You get transformed life; you get international brotherhood. He takes the message of sanitation, to be sure; but he lives the life that shares, and makes friends by sharing. In such men that have represented Jefferson, and in the thousands more that will represent Jefferson, you may rest your hopes. They go, not to get, but to give; and not to give merely, but to unite the world in sharing a common life.

As I have watched the graduating class arrayed in academic cap and gown, I have thought of a similar commencement occasion in Changsha in June, 1921, when the first class graduated from the Hunan-Yale

College of Medicine. A Chinese professor of history, seeing the academic garb, exclaimed: "You have borrowed the ceremonial costume of the T'ang dynasty!" The west has indeed received from the east!

And I think also of the great cathedral in Peking, the site for which was given to the Jesuit fathers by the great emperor Kang Hsi in 1698 after he was cured of malaria by the Peruvian bark which these fathers had brought with them. The west was sharing with the east its medical discoveries.

It is in this spirit that I look forward to the going out of the graduates of Jefferson Medical College to-day, that they shall endeavor to find, wherever their lot is cast, elements that may enrich and strengthen the common humanity of which we all are a part.

EDWARD H. HUME

THE COLLEGE OF MEDICINE,
YALE IN CHINA,
CHANGSHA

THE NET ENERGY CONCEPTION[1]

THE net energy conception of Armsby is the simplest and most inclusive of all general measures of nutritive value.

Net energy is the remainder after the deduction of all expenses and losses of utilization from the gross income of energy. Protein as well as non-nitrogenous nutriment contributes to the net energy, having an energy value, after its use as protein, and after deaminization, approximately equal to carbohydrate.

More specifically, the net energy of a feed is its total heat of combustion, that is, its gross energy, minus the energy equivalent of the feces, the urine, the epidermal offal, the methane and the heat produced by fermentation of carbohydrates in the alimentary tract, and the energy represented by the increase in heat production due to the feed consumption and utilization.

In terms of its use by the animal, the net energy of a feed is a measure of its capacity to contribute to maintenance, work and material production—as of flesh, milk, eggs, wool, etc.

The net energy conception implies nothing as to the method of utilization of the net useful nutriment. It simply measures that part of the total which is useful. Net energy may be used to supply any requirement, of whatever nature, for energy-producing nutriment.

Feeding standards based on the net energy conception, therefore, must consider all those conditions of practice which determine quantitative feed requirement in exactly the same way as do all other feeding standards.

[1] From an address before the American Society of Animal Production on December 2, 1923.

The use of net energy values does not imply that the total nutritive value of a feed or the entire nutritive requirement of an animal can be expressed in these terms. In fact, since the net energy value of a feed expresses its worth for only the one class of requirement implied by its designation (net energy) it is necessary in basing a feeding standard on this conception to make separate statements of other nutritive requirements, as of protein, mineral nutrients, etc., just as in the case of other feeding standards.

The justification for the use of net energy values as measures of food value generally is that, no matter what the purpose for which an animal is fed, several times as much nutriment is used, directly and indirectly, for energy production as is used for any other purpose or all other purposes combined. Admittedly, net energy is not a complete measure of nutritive value; no one unit can possibly measure the entire nutritive value of a feed, because nutrition involves several classes of nutrients, each of which is essential in the sense of not being replaceable by another. But net energy is the best possible standard for the expression of the most extensive nutritive requirement, and is, in this sense, the best possible single measure of food value generally.

Net energy of the same feed for different kinds of animals, or for different kinds of production, does differ, and so must be determined separately.

The following factors have determinable but practically negligible effects on net energy values: individuality, plane of nutrition, feed combinations (in relation to digestive efficiency and the dynamic effects of feeds), and the physical condition of feeds, as related to digestibility and energy-cost of handling.

Thermal environment, below the critical temperature, decreases net energy values, but in practice this does not ordinarily happen, because it is more profitable to keep the thermal environment above the critical temperature.

The following conditions affect quantitative feed requirement, but not the net energy values of feeds:

Exercise, as affected by fatness, sex, temperament, breed and type; light, as a stimulus to metabolism; age, as affecting intensity of metabolism, especially oxidative functions; temperature of air, feed and water, humidity of air, and wind velocity—so long as these factors, combined, do not exceed the animal's capacity for physical heat regulation.

The net energy conception, therefore, affords a discriminating method for determining and expressing important differences in feeds which are not revealed by other systems of feed comparison; recognizes the final energy-value of the protein of the feed; recognizes not only liquid and solid wastes, but also wastes in gaseous form and as heat; recognizes the different

nutritive cost of different kinds of production; distinguishes between the net portion which is useful and the large fraction which is useless, in feeds; and is scientifically significant in being expressed in the unvarying terms of physical measurements.

The newer knowledge of nutrition, especially regarding proteins, mineral nutrients and vitamins, has been quite without direct effect to modify the previous understanding as to energy metabolism.

Like any general measure of nutritive value, net energy is essentially a conception of convenience, and not an absolute standard, since it must ignore the finer points of specific effects of foods.

It can not be fairly judged from the point of view which regards each feed and each ration as presenting a separate chemical problem. In this light no feeds are comparable by any common measure.

Following the presentation of this paper a committee of the society was appointed to formulate a resolution expressing its attitude toward the net energy conception of Armsby, and the work of the Pennsylvania Institute of Animal Nutrition. The following resolution was reported and unanimously adopted:

Resolved, That the American Society of Animal Production, in annual convention assembled, strongly endorses the program of work of the Pennsylvania Institute of Animal Nutrition.

Scientists throughout the world realize the outstanding importance of the classical researches conducted at this institute by the late Dr. H. P. Armsby and his associates with the respiration calorimeter.

These investigations have revealed many important fundamental facts regarding the nutrition of farm animals and have furnished the most accurate quantitative measure of the productive value of different feeding stuffs.

The society endorses the Armsby conception of net energy values derived from his researches with the respiration calorimeter. It realizes that on account of the time and expense involved in net energy determinations it was possible for Dr. Armsby and his colleagues to make direct determinations on only a limited number of feeds. Furthermore, the larger proportion of the investigations have been conducted with steers. The society therefore appreciates deeply the importance to the animal industry of this country and of the world of continuing these researches and extending them to include the other classes of farm animals.

These investigations are of a type which involve great expense, and furthermore, are of world-wide importance. It is fitting, therefore, that the greatest possible use be made of the equipment of this institute which is the only such apparatus in the world.

Realizing the need for the continuation and expansion of this work the society strongly recommends that the United States Department of Agriculture extend to the Pennsylvania Institute of Animal Nutrition the fullest cooperation and support.

(Signed) FRANCIS G. BENEDICT,
JOHN M. EVVARD,
A. J. GRAMLICH,
A. G. HOGAN,
F. B. MORRISON, *Chairman*

Subsequently, the writer reviewed this action by the Society of Animal Production before the Subcommittee on Animal Nutrition of the National Research Council, of which he is the chairman; and this committee expressed its approval of the action of the society.

E. B. FORBES
THE INSTITUTE OF ANIMAL NUTRITION OF
THE PENNSYLVANIA STATE COLLEGE

SCIENTIFIC EVENTS

THE LONDON AQUARIUM

THE new aquarium in the Zoological Gardens was opened to fellows and their friends on April 5 and 6, and to other visitors to the gardens from April 7.

According to an article in the London *Times* the installation is the greatest enterprise undertaken by the Zoological Society in the course of its history, now nearly a century long. The building is placed under the Mappin Terraces, the hills of which conceal the high level reservoirs of the circulation system and give the necessary protection from inequalities of temperature. The area occupied is a crescent, following the curve of the hills and is almost exactly 450 feet in length. There are 25 tanks, ranging in length from 30 feet to 6 feet, for fresh-water creatures; 17 tanks, the largest two of which are over 30 feet, for marine animals; and there are 40 smaller tanks for tropical fish. The total cost of erection, equipment and stocking has been nearly £54,000, met partly by realization of the society's freehold property and partly by a loan guaranteed by the president, the Duke of Bedford, and the Fishmongers' Company. To provide for the cost of maintenance and a sinking fund for the debt nearly £10,000 a year will be required, and it is therefore necessary to make a charge for visits to the aquarium in addition to the payment for entrance to the gardens.

The anterior is divided into three halls, each with the same scheme of decoration, designed to show the aquatic creatures to the best advantage. The floors are paved with dark rubber, silent and pleasant to the foot, and the walls, columns and ceiling are enamelled in shining black. There are pendant electric lights in case of need, but the general illumination comes only through the windows of the tanks. Each of these is set back in a deeply shelving frame of dark green marble composition. The general

effect is that of a picture gallery, its two curved walls hung with a series of pictures all "on the line." But the pictures are living. Each has a background of natural rock, grey or red granite, weathered limestone, sandstone, or slate, some with natural fossils, others with corals or giant shells, and each composing a distinct scene of subaqueous beaches and ledges, shelving rocks or tumbled boulders.

The aquarium requires a special staff, Mr. E. G. Boulenger, formerly curator of reptiles, has been appointed director, and has superintended every detail of construction and equipment. Mr. Vinall, formerly head keeper at the reptile house, is his chief assistant, and was sent to the aquarium at Amsterdam last summer for special training. There are two assistant keepers, an electrician and three stokers.

Since 1912 the secretary of the society and Mr. Boulenger have been collecting information from all the existing aquaria, and Messrs. Belcher and Joass, the architects of the Mappin Terraces, prepared the detailed architectural plans to their general designs. Miss Joan B. Proctor, now the society's curator of reptiles, made the designs and prepared scale models of all the rockwork, beside arranging the actual rockwork in some of the smaller tanks. Dr. Allen, director of the Plymouth Laboratory of the British Marine Biological Association, Dr. Townsend, director of the New York Aquarium, and many other experts gave much valuable advice.

THE MOTOR VEHICLE TRAFFIC CONFERENCE AT YALE UNIVERSITY

A CONFERENCE on Motor Vehicle Traffic, with special reference to regulation, control and safe operation, was held in New Haven on April 9, 10 and 11, under the joint auspices of the State of Connecticut and Yale University. The purpose was to consider the causes of accidents due to motor vehicle traffic and to discuss methods of preventing such accidents. Funds to defray the expenses of the conference and to provide for printed proceedings have been given by Mrs. Helen Hartley Jenkins, of New York City, through the Hartley Corporation, of which Mrs. Jenkins is president.

The causes of more than 15,000 motor vehicle accidents which happened in Connecticut during 1923 have been analyzed by the department of civil engineering of Yale University in cooperation with the department of motor vehicles of Connecticut. These accident statistics were presented at the opening session on Wednesday, April 9. This was followed by a discussion of "Laws governing traffic" and by a paper on "The mind of the operator." Under the general topic of "Accident prevention," papers were presented on Thursday, April 10, on "The education of school children and the general public," "Highway improvement," "Traffic regulation and control," "Police methods," "Laws and court systems," and "Motor vehicle department procedure." The third day, Friday, April 11, was devoted to a discussion of specific Connecticut problems such as "Highways," "Street railways," "Public service motor vehicles," "The traffic policing of highways," and "The traffic policing of city streets." The keynote of the sessions of this day especially, as for the whole conference, was accident prevention.

Among those who expected to present papers during the conference are W. M. Maltbie, judge of the Superior Court of Connecticut; T. W. Salmon, associate professor of psychiatry of Columbia University; A. M. Meredith, commissioner of education of Connecticut; E. G. Payne, professor of education of New York University; F. S. Greene, superintendent of the department of public works of New York; W. P. Eno, Washington, D. C.; A. S. Foote, commissioner of public safety of Massachusetts; D. A. Adams, secretary of the New Haven Automobile Club; W. L. Dill, commissioner of motor vehicles of New Jersey; R. B. Stoeckel, commissioner of motor vehicles of Connecticut; J. A. Macdonald, highway commissioner of Connecticut; L. D. Storrs, president of the Connecticut Company; R. T. Higgins, chairman of the Public Utilities Commission of Connecticut; R. T. Hurley, head of the State Police of Connecticut; G. H. Farrell, chief of police of Hartford, Connecticut, and P. T. Smith, chief of police of New Haven.

The State of Connecticut is said to have the most complete organization in this country for the systematic reporting, analyzing and recording of all motor vehicle accidents within a state. This conference was part of a determined effort to reduce the number of such accidents. The critical study of the causes of such a large number of accidents yields data upon which to base future legislation and the education of the general public in the prevention of accidents. While the conference primarily concerned Connecticut, representatives of other states were invited to take part in the discussions, and it is hoped that it will result eventually in an appreciable reduction in the number of motor vehicle accidents not only in Connecticut, but throughout the country.

Robbins B. Stoeckel, commissioner of motor vehicles of Connecticut, representing Connecticut, and Professor John C. Tracy, chairman of the department of civil engineering of the Sheffield Scientific School of Yale University, representing the university, were in charge of arrangements for the conference.

THE AMERICAN GEOGRAPHICAL SOCIETY

THE *American Geographical Society of New York* announces the award of three gold medals for the year 1924 as follows:

The Cullum Geographical Medal to Professor Jovan Cvijić.

The Charles P. Daly Medal to Colonel Claude H. Birdseye.

The David Livingstone Centenary Medal to Frank Wild.

Professor Cvijič's achievements are well known to all students of Balkan geography, for he has made the most substantial and original contributions in this field. The inscription upon the medal is as follows:

JOVAN CVIJIĆ
1924
For the scholarship displayed
in his published works
on the geography of the
Balkan countries and for the
originality of his field
studies on the complicated
physiography of the Karst.

Colonel Birdseye is the author of several technical papers in the field of surveying, did distinguished work for the artillery service during the war, and during the summer of 1923 repeated Powell's famous exploit of descending the Grand Canyon of the Colorado by boat as leader of a topographic and hydrographic party to study the water-power possibilities of the Canyon.

Frank Wild played an important part in the Scott expedition to the Antarctic, 1901–04; Shackleton's expedition, 1907–09; Sir Douglass Mawson's expedition, 1911–14. He was second in command on the Shackleton expedition of 1914–17 and during the recent expedition of the "Quest."

The Society announces further the election to honorary corresponding members of three scientists who have done distinguished geographical work, as follows:

Dr. Edwin R. Heath, of Kansas City, Mo.
Dr. H. L. Shantz, of Washington, D. C.
M. Paul Le Cointe, of Belem (Pará), Brazil.

Dr. Heath is well known for his early explorations in South America, having explored the Rio Beni region in 1880. In honor of his distinguished work a branch of the Rio Beni north of Lake Titicaca has been called the River Heath. The first statement of his explorations is given in the *Journal of the American Geographical Society* for 1882.

Dr. H. L. Shantz, of the Department of Agriculture, Washington, D. C., has made notable explorations in Africa and he is now engaged upon further study in plant ecology in that field. He is joint author with Dr. C. F. Marbut of Research Series No. 13, "Vegetation and Soils of Africa" (with colored maps), published by the American Geographical Society in cooperation with the National Research Council.

M. Paul Le Cointe, of Belem (Pará), Brazil, is the author of "L'Amazonie brésilienne: Le pays—ses habitants, ses ressources, notes et statistiques jusqu'en 1920," a work of high distinction, especially when the difficulties to be overcome in gathering and publishing the material are considered. Of particular importance are his discussions of the climate, economic development and forest life of Amazonia.

THE SOUTHWESTERN DIVISION OF THE AMERICAN ASSOCIATION

THE fifth annual meeting of the division will be held in El Paso, Texas, on Monday, Tuesday and Wednesday, May 5, 6 and 7. The registration and general meetings will be held in the Temple Mt. Sinai, corner of North Oregon and Montana Streets. Members are especially urged to prepare papers dealing with their original research in any line, and, whether they have yet heard from the chairman of the appropriate section or not, to send the titles of such papers immediately to the section chairman and also to the chairman of the executive committee, so that they may be sure to be listed in the printed program.

A time limit of twenty minutes will be set for the reading of any paper. The program committee desires therefore that in the actual presentation of papers, only the more important parts be given. Omitted parts and reference to authorities will of course be included in any subsequent publication.

Communications regarding papers should be addressed to the chairman of the section before which paper is to be read. They are:

Physical Science: Mr. A. L. Flagg, Goodrich Building, Phoenix, Arizona.

Biology: Dr. Forrest Shreve, Desert Botanical Laboratory, Tucson, Arizona.

Social Science: Mr. Paul A. F. Walter, First National Bank, Santa Fe, New Mexico.

The officers are:

Byron Cummings, *President*, Arizona State Museum, Tucson, Arizona.

Elliott C. Prentiss, *Vice-president*, El Paso, Texas.

Robert S. Trumbull, *Secretary-treasurer*, El Paso, Texas.

The Southwestern Division embraces members who reside in Arizona, Colorado, New Mexico, Texas west of the Pecos River, Chihuahua and Sonora.

SCIENTIFIC NOTES AND NEWS

DR. T. MITCHELL PRUDDEN, emeritus professor of pathology in Columbia University and a member of the board of directors of the Rockefeller Institute for Medical Research, died in New York on April 10, in his seventy-fifth year.

PROFESSOR ELWOOD MEAD, of the University of California, has been appointed by President Coolidge director of the Reclamation Service, replacing David W. Davis. It will be remembered that about a year ago Arthur Powell Davis's resignation was forced by the Secretary of the Interior, and the appointment given to David W. Davis, who is not an engineer. Dr. Mead is now professor of rural institutions in the University of California. He had previously been professor of irrigation in the Colorado Agricultural College, chief of irrigation investigations in the U. S. Department of Agriculture and chairman of the State Water Supply Commission, Victoria, Australia.

DR. G. G. HENDERSON, F. R. S., regius professor of chemistry, in the University of Glasgow, was elected president of the Institute of Chemistry of Great Britain, at its forty-sixth annual meeting, on March 3, 1924, to succeed Dr. Alfred Chaston Chapman, who has served as president during the past three years.

DR. W. CH. BRÖGGER, professor of mineralogy in the University of Christiania and Dr. Edmund Landau, professor of mathematics in the University of Göttingen, have been elected corresponding members of the Prussian Academy of Sciences in the physical-mathematical section.

THE University of Paris proposes to confer an honorary degree on Professor S. Ramón y Cajal, of Madrid, the distinguished histologist.

WE learn from *Nature* that at a meeting of the Royal Society of Edinburgh held on March 17, the president, Professor F. O. Bower, announced that the Keith prize for the period 1921–1923 had been awarded to Professor J. W. Gregory, professor of geology in the University of Glasgow, for his papers published in the *Transactions* of the society, and in recognition of his numerous contributions to geology extending over a period of thirty-six years; and that the Neill prize for the period 1921–1923 had been awarded to Professor J. McLean Thompson, professor of botany in the University of Liverpool, for his series of memoirs on staminal zygomorphy and on the anatomy of the Filicales.

A COMMITTEE of engineering alumni of Cornell University is collecting a fund to place a portrait of Professor Henry S. Jacoby beside those of Dean Estevan A. Fuertes, Professor Irving P. Church and Professor Charles L. Crandall, which were presented to the college by the Cornell Society of Civil Engineers some years ago. More recently the Cornell Society of Engineers has presented portraits of Deans Albert W. Smith and Eugene E. Haskell, which are now on exhibition at the Cornell Club of New York. Professor Jacoby went to Cornell University in 1890.

PROFESSOR WALTHER NERNST, for the past two years president of the *Reichsanstalt*, the German national physical laboratory, will resume his former position of professor of physics and director of the physical laboratory of the University of Berlin.

PROFESSOR DOUGLAS JOHNSON, of Columbia University, has been elected an honorary member of the Geographical Society of Bordeaux. In connection with his service as exchange professor to the French universities, he recently gave a series of lectures at the University of Algiers, after which he visited the Atlas Mountains and the northern part of the Sahara Desert as guest of the French authorities in Algeria.

PROFESSOR E. M. CHAMOT, of the department of chemistry of Cornell University, has been appointed American exchange professor of applied science at French universities during the ensuing academic year.

DR. STANLEY W. KEMP, superintendent of the zoological survey of India, has been appointed director of research on Captain Scott's old ship, the *Discovery*. This vessel is being reconditioned in order to undertake research, mainly into whaling, in the dependencies of the Falkland Islands on behalf of the colonial government.

DR. VAN H. MANNING, formerly director of the Bureau of Mines, and since June 1, 1920, director of research, American Petroleum Institute, has resigned to direct research for the Pan-American Petroleum & Transport Co., New York. Harmon F. Fisher, also formerly of the institute, is now in charge of production, Knox Process Co., Texas City, Texas.

THE annual meeting of the Undergraduate Medical Association of the University of Pennsylvania Medical School was held on April 4. Mr. Charles H. Best lectured on the "Discovery and development of insulin." The annual Mary Ellis Bell Prize for the best undergraduate work in medical research was given to Messrs. Landis, Long, Dunn, Jackson and Meyers (all second year students) for their work on the "Effects of hot baths on respiration, blood and urine."

THE seventh Silvanus Thompson memorial lecture before the Röntgen Society, London, was given by Professor C. G. Barkla, F.R.S., of Edinburgh. The subject of the lecture was "Some recent investigations in X-rays—the 'J' phenomena."

IN response to the invitation of the Kelvin Centenary Committee, the Council of the American Society of Mechanical Engineers has made appointments of members of the society to represent it at the centenary celebration in England this summer, as follows: Ambrose Swasey, honorary member and past-president of the American Society of Mechanical Engineers, was appointed representatives on the Committee of Honor of the Kelvin Centenary Celebration, with President Fred R. Low as alternate. Calvin W.

Rice, secretary of the society, was appointed to represent the society at the Kelvin Centenary Celebration, the summer meeting of the Institution of Mechanical Engineers, and the joint meeting of the Institutions of Civil and Electrical Engineers, all of which will be held in London this summer.

THE committee on scientific research of the American Medical Association, in addition to grants already reported, has made a grant of $300 to Dr. Addis, of Stanford University Medical School, for the furtherance of an investigation into the factors which influence the rate of compensatory hypertrophy of the kidney in rats after unilateral nephrectomy.

DR. DONALD REDDICK, professor of plant pathology at Cornell University, has been granted sabbatic leave and sailed on April 9 to spend several months in study in European universities.

DR. G. ELLIOT SMITH, professor of anatomy in the University of London will give a series of three lectures under the Herter Foundation of the University and Bellevue Hospital Medical College on "The human brain in the light of its evolution." The lectures will be given on consecutive days at four o'clock in the afternoon at the Carnegie Laboratory, 338 East Twenty-sixth Street, beginning on Monday, April 28.

PROFESSOR PAUL EHRENFEST, of the University of Leiden, is lecturing in the United States. He gave four lectures on "Some problems of quantum statistics" in the department of physics of the University of California, beginning on March 14.

AT the meeting of the Philosophical Society of Washington on April 19 the address will be given by Professor W. M. Davis, of Harvard University, on "Some oceanographic problems in connection with coral reefs."

ON April 14 and 15, George C. Whipple, professor of sanitary engineering at Harvard University, gave two lectures before the Sigma Xi Society at Chapel Hill, North Carolina, one on "The biology of stream pollution; the other on "The philosophy of sanitation." During the week of April 14 to 19 he visited the University of Virginia and Trinity College at Durham, North Carolina.

DR. L. R. JONES, professor of plant pathology at the University of Wisconsin, delivered five lectures at the Massachusetts Agricultural College at Amherst during the first week in April.

DR. FERNANDUS PAYNE, professor of zoology in the University of Indiana, visited the Kansas State Agricultural College over the week end of March 28–30, and gave an address on "The rôle of mutation and selection in evolution."

DR. PAUL E. KLOPSTEG, director in charge of manufacturing and development of the Central Scientific Company, addressed on April 4, the members of the Society of Chemical Industry at Toronto on "The measurement of hydrogen ion concentrations."

PROFESSOR LYMAN C. NEWELL, head of the department of chemistry in Boston University, delivered an address on "The earlier and later days of chemistry in New England" at the twenty-fifth anniversary meeting of the New England Association of Chemistry Teachers, held on March 15, in Malden, Mass., where the organization was founded. The address was illustrated with lantern slides, portraits and autograph letters from Dr. Newell's collection. In recognition of his services to the association Dr. Newell was presented with a copy of resolutions adopted at this meeting. The resolutions acknowledge the work which Dr. Newell has done for the society and express the thanks of the organization for his unbroken services in many ways. Dr. Newall was a moving spirit in the formation of the association. He was its first president, and now holds the office of curator of the library and museum.

PROFESSOR MERRITT R. GROSE, head of the department of chemistry of Temple University, died of pneumonia on March 26. He obtained his training in chemistry at the University of Chicago, Harvard University and Columbia University and had taught at Findlay College, Ohio, and Syracuse University before going to Temple University.

WILLIAM HENRY MAW, for fifty-eight years editor of *Engineering*, probably the most influential technical journal in Great Britain, past president of the Royal Astronomical Society, died on March 19, at the age of eighty-five years.

DR. R. E. FROUDE, F.R.S., lately superintendent of the British Admiralty Experimental Works, Gosport, died on March 19, aged seventy-seven years.

THE death is announced at the age of seventy-four years of Dr. Ludwig Graff, emeritus professor of zoology at the University of Graz.

THE spring meeting of the American Society of Mechanical Engineers will be held at Cleveland from May 26 to 29.

THE annual meeting of the German Surgical Society will be held at Breslau, under the presidency of Professor Braun, of Zwickau, from April 22 to 26. The principal subjects for discussion will be surgery of the lung, transfusion of blood, and open treatment of fractures.

THE Belgian Minister of the Interior and of Public Health has included in his budget a proposal to spend a million francs this year on a campaign against cancer. Treatment centers would be established in

university towns at first, and later in other large communities.

AN amendment to the Department of Agriculture appropriation bill has been submitted by Senator Harris, of Georgia, to appropriate $100,000 "for the extermination and prevention of the cotton boll weevil, including an investigation of processes of the manufacture of calcium arsenate and other poisons" to be used in connection therewith.

OFFICERS and faculty members of the University of Richmond, Richmond, Va., have acquired life insurance protection through an arrangement with the Metropolitan Life Insurance Company, which became effective on March 17. Under the terms of the group insurance policy, the president of the university, the vice-president and treasurer and the dean receive protection of $5,000. The faculty members receive $4,000. There are 51 persons in the insured group. The university pays part of the premiums and the insured individuals themselves contribute a part. A nursing service is maintained and will be available to the insured in the event of illness.

THE biological laboratories of the United States Bureau of Fisheries at Woods Hole, Mass.; Beaufort, N. C., and Fairport, Iowa, will open on June 20, and are expected to remain in active operation until about September 15. A limited number of research rooms and tables will, as usual, be available to those qualified to conduct investigations in the various branches of marine and fresh-water biology. At Fairport there is a new and well-equipped laboratory, with needed collecting apparatus and ponds and tanks. Both river water and filtered water are provided. This field offers opportunities for zoological and botanical investigations as well as for chemical studies relating to biological problems. Those desiring to have the use of tables and other facilities at these laboratories may communicate with Henry O'Malley, Commissioner of Fisheries, Washington, D. C.

A REPORT in *The Experiment Station Record* of a monograph by Dr. E. W. Allen, E. R. Flint and J. I. Shulte in regard to the work and expenditures of the agricultural experiment stations for 1921, states that for the fiscal year, the total income reported by the stations from all sources was $7,660,570.77. This amount includes $1,440,000 derived from Federal sources under the Hatch and Adams Acts and $210,000 appropriated by the federal government for the experiment stations in Alaska and the insular possessions. The support of the stations from within the states included $3,786,997.94 derived from state appropriations or apportionments, $359,964.92 from fees, $1,167,856.62 from the sale of farm and other products, $371,421.86 from miscellaneous sources, and $534,329.43 carried over as balances from the previous year. During the year the stations added equipment aggregating $992,308.03 and classified as follows: Buildings $459,644.38, library $29,023.53, apparatus $67,598.63, farm implements $107,490.62, livestock $147,229.36, and miscellaneous $181,321.51. In the work of administration and inquiry the stations employed 1,965 persons. Of these, 1,023 were also members of the teaching staffs of the colleges and 434 assisted in the various lines of extension work.

Nature states that for the last decade the French Jesuit Father Licent has been exploring the fossiliferous deposits of northern China, and has sent some valuable collections to Paris, including a fine series of remains of Pliocene mammals. A year ago he was joined by Father Teilhard de Chardin, professor of geology in the Catholic University of Paris, who has had much experience of collecting in the caverns and rock shelters of France and Spain, and was associated with the late Mr. Charles Dawson in collecting from the river gravel at Piltdown, Sussex. According to a despatch from Peking to the *Manchester Guardian*, Fathers Licent and Teilhard have now made an important discovery of human remains at a depth of sixty meters in a river deposit in northern Kansu, through which the existing river Shara Osso Goh has cut a deep gorge. There seems to be evidence of six individuals, and one well-fossilized skull with retreating forehead and large orbits may prove to be of special interest. No lower jaw was found. With the human remains there occur numerous bones of rhinoceros, horse, bison, camel, deer, elephant and other mammals. One horse is said to be no larger than a collie dog. It is reported from another source that at least ten well-preserved skulls of rhinoceros have been obtained, and that they closely resemble the skull of the ordinary woolly rhinoceros. With the human and other remains there are also numerous small rude implements of quartzite.

WE learn from *Nature* that a new laboratory for marine biological research was opened at Batavia on December 12 last. This, the first of its kind to be established close to the equator, offers opportunities to naturalists desirous of investigating the problems of marine life in the tropics. For the zoologist there are rich fields of study around Batavia, including the river fauna of the Tji Liwung, the brackish life in the estuary and coastal ponds, and the varied marine fauna of the Sea of Java. For the botanist, there is a fine collection of East Indian beach and coast plants in the garden surrounding the laboratory, and easy access to the famous Botanical Gardens at Buitenzorg. The station consists of two main buildings, the laboratory facing the sea, and the aquarium behind it. The buildings are well equipped and are lighted

throughout by electricity. In the laboratory a large room has been fitted up for the use of visiting naturalists, five of whom can be accommodated at the same time. They have at their disposal certain of the aquarium tanks and table-aquaria, as well as two boats for collecting fresh material, the *Max Weber*, working in the vicinity, the other a steamer of 322 tons displacement, the *Brak*, for longer voyages.

BACTERIOLOGISTS having cultures of red chromogenic bacteria are requested to forward sub-cultures to Mr. R. S. Breed, New York Agricultural Experiment Station, Geneva, N. Y. A monographic study of this group of bacteria is in progress and comparative material is needed. Records of source, time of isolation and by whom isolated should accompany cultures. Proper credit will be given in publications for any assistance given.

DR. J. F. ILLINGWORTH, formerly professor of entomology in the University of Hawaii, after spending four years in Australia on a special investigation of the pests of sugar cane for the Queensland government, has returned to his home at Honolulu, where he has been appointed research associate in entomology at the Bishop Museum. At present Dr. Illingworth is engaged as specialist on the Green Japanese Beetle problem, by the U. S. Department of Agriculture, and is traveling in the Orient. The past season was spent in a general survey of this pest in Japan, where, unfortunately, he lost all his equipment in the Yokohama catastrophe. Since Dr. Illingworth is to investigate Chinese territory during the coming season, he has selected Shanghai as temporary headquarters, care of the American consul.

UNIVERSITY AND EDUCATIONAL NOTES

CONTRACTS have been awarded for the construction of the hall of chemistry for the University of West Virginia, Morgantown, which will be erected at a cost of $750,000.

IT is planned to build a hospital at the Ohio State University at Columbus at a cost of $500,000.

THE London County Council Education Committee has agreed to recommend the council to establish two Sir Robert Blair fellowships for applied science and technology, each of the value of £450 for one year.

THE board of regents of the University of Michigan Medical School has approved a combined course in pharmacy and medicine for students who wish to prepare for scientific careers in research laboratories, or for educational, scientific or pharmaceutical manufacturing institutions. The new combination course requires three years in the College of Pharmacy and two years in both the pharmacy and the medical schools. The five years of study leads to a degree of bachelor of science in pharmacy. Two more years in the medical school will give the degree of doctor of medicine.

AT Yale University the appointments of five instructors on the faculty to assistant professorships are announced. These include Arthur H. Smith, physiological chemistry; Erwin George Gross, pharmacology and toxicology; Howard W. Haggard, applied physiology, and Lester C. Lichty, mechanical engineering.

THE *Bulletin* of the American Mathematical Society records the following promotions and appointments: Associate Professor S. Lefschetz, of the University of Kansas, to a full professorship of mathematics; Associate Professor J. W. Calhoun, of the University of Texas, to a full professorship of applied mathematics; Mr. A. S. Hathaway to be professor of mathematics at Friends University, Wichita, Kansas; Assistant Professor E. C. Keifer, Iowa State College, to be head of the department of mathematics at James Millikin University; Professor D. A. Lehman, of Goshen College, to be professor of mathematics at Bluffton College.

PROFESSOR A. E. JOLLIFFE, M.A. (Oxford), has been appointed to the university chair of mathematics, of the University of London, tenable at King's College.

DR. HANS KNIEP, of the University of Würzburg, has been appointed professor of botany at the University of Berlin to succeed Professor Haberlandt.

DR. FRIEDRICH MULLER, of the University of Tübingen, has been appointed professor of anatomy in the German University at Prague.

DISCUSSION AND CORRESPONDENCE

THE METRIC SYSTEM IN AGRICULTURE

FROM time to time there have appeared in SCIENCE suggestions for promoting the adoption of the metric system of weights and measures in the United States. One promising field of propaganda that has apparently been neglected by devotees of this rational system of measurements is that of reports of agricultural experimentation. On account of the wide distribution of such reports and the large number of persons reached the influence of such propaganda on the popular mind probably would be great. For those interested in the movement and occupying positions permitting the use of them, the following concrete suggestions are made:

(1) That new, especially long-time, experimental fields be platted in units of the metric system, and results from them be reported in both the metric and English systems.

(2) That results from field and other experiments, not laid out in the metric system, be reported in technical bulletins, also in a few selected popular bulletins, in terms of the metric and English systems.

After all, such reporting of results would not be a radical departure from the usual method, for research workers are quite familiar with the metric system from their study of European literature. Also, it is comparatively easy to transpose from one system to another; for a meter is comparable to a yard and the expression, kilograms per hectare, is approximately the same as our common expression, pounds per acre.

In the platting of new experimental fields in the metric system those in charge would not only be furthering a worthy propaganda but probably would be preparing their experiment station and its constituents for an inevitable change; for many of the long-time experimental fields are expected to be used as laid out for thirty years or longer, and it is very likely that such a period will see the virtual, if not complete, adoption of the metric system in this country.

It is not necessary at this time to enumerate all the forces that are expected to bring about the adoption of the metric system or the advantages of the system in agriculture; a few will suffice. We are, as a nation, fast becoming internationally minded; a common system of measurements becomes more inportant. History is being made rapidly nowadays; events that formerly took generations for accomplishment now occur over-night. Important data and events are being published both in technical and popular publications in units of the metric system.

As against the disadvantages of readjustment in changing from the English to the metric system, we may place the advantages of saving of labor and time in calculations and of more simple and rational division or combination of field plots. The meter is a little better than the yard for distance between large intertilled crops; and the are or hectare can easily be made to contain plants numbering multiples of tens where an exact number of plants is desirable.

A. B. BEAUMONT
MASSACHUSETTS AGRICULTURAL COLLEGE

SUCCESS OUT OF FAILURE

BY how narrow a margin success is at times separated from failure is of daily experience in business affairs. It is not appreciated how it is of importance also in scientific matters. Langley died broken hearted over the criticisms and ridicule he was given about his airplane. Yet Curtiss, putting a more powerful engine in it, vindicated Langley's theories and to-day his name is preeminent in aeronautics.

Oersted, the Danish physicist, in 1819, noticed the deflection of a magnetic needle by the action of a current flowing through a copper wire near the needle. Ampère, a mathematical prodigy at 13, immediately on hearing of the experiment, amplified the subject and in a short space of time worked out the laws which have become the basis of electro-dynamics. We owe to him the word "galvanometer," the instrument which measures current strength. We now denote the unit of current strength as the Ampère, and Ampèremeters are familiar instruments.

Ampère was so profoundly impressed from his mathematical studies of the subject that he made few experiments to verify his theories. He spoke of them as demonstrated. He was as sure of his hypotheses as Leverrier, the astronomer, was from his calculations of the orbits of the planets convinced that another planet must exist in a particular region of the heavens at a certain time. The discovery of the planet named Neptune was a remarkable verification of abstract scientific theory.

So Ampère, as it is related by Rauol Pictet, the eminent Swiss physicist, who liquefied oxygen and other gases and thus paved the way for wonderful developments in chemistry, biology and physics, was induced to give an experimental demonstration of his theories. The audience hall of the Observatoire was chosen for the event and a brilliant audience gathered.

Ampère discoursed on his theories. His blackboard demonstrations were convincing.

According to theory, a coil of insulated copper wire if suspended should place itself parallel to the equator when a galvanic current is passed through it. One face of the coil should point north, the other south. These faces should be attracted or repelled by a magnet brought near, as a north pole of a magnet is attracted by a south pole of another magnet, or repelled by a north pole. Indeed, two suspended coils or "solenoids" should behave like two magnets.

Many pieces of apparatus had been built to verify the postulates of Ampère, but the firm which made them delivered them on the lecture table too late to test them out.

When Ampère, with the assurance and complete conviction that the coils would behave as predicted, made the demonstration, one after another of the pieces failed to respond. The audience, appreciating his distress of mind, gradually dispersed, and he, returning home with tears streaming down his face, so Daniel Colladon, his assistant, told Pictet, sought consolation in a game of chess with a dear friend.

Colladon, expert mechanician, immediately tested the pieces of apparatus. A common defect was found in a too great friction of the bearing surfaces to be overcome by the feeble currents employed.

He devised a new method of suspension. The ends

of the wires were made to dip into mercury held in metallic cups connected to the poles of the battery. Thus, though conduction was assured, there was practically no friction in the bearings.

Colladon tested out each piece of apparatus and at last joyfully sought Ampère near midnight, dragged him from his game of chess to the laboratory at the Collège de France, and forced him to witness the entire series of experiments successfully carried out.

Ampère then summoned his audience to a second lecture and in highly successful experiments established his prophecies and demonstrated the laws he had enunciated.

CHARLES A. DOREMUS

BREADFRUIT IN THE MARQUESAS

IN the January 18, 1924, issue of SCIENCE, page 64, Mr. P. J. Wester writes from Manila, urging an expedition to the Marquesas and other South Sea Islands, primarily for the purpose of making secure the continued existence of the breadfruit, secondarily, by a study of the varieties, to add further evidence relative to the migrations of these inhabitants of Polynesia.

He invites correspondence, hence this communication. Mr. Wester refers to statements in the romantic "White Shadows in the South Seas," and to the interesting article by Church in the *Geographic* for October, 1919, and mentions Church's prediction that in ten years from that date "there would not be a full-blooded Marquesan alive." If taken literally, this would mean that the year 1929 or 1930 will witness the extinction of all pure-blooded Marquesans, and consequently, very shortly after, according to Wester, the gradual dying out of all Marquesan breadfruit.

I have just returned from a seven months' trip to the Marquesas, and while the situation, due to the degrading influences of so-called civilization by the whites, is serious enough from a humanitarian standpoint, I can hardly share, to its fullest extent, Mr. Wester's rather doleful outlook, either as regards the complete extinction of the true Marquesan or the extinction of the breadfruit resulting from the disappearance of the full-blooded native.

The present population of all the six inhabited islands of that group of eleven, numbers, according to Mr. Frank Varney, a long-time resident on Hivaoa, about 1,000 or 1,200. Only a small proportion of these are pure bloods, most of that number being natives from the Tuamotus or the Society Islands, and many of them are half-bloods or quarter-bloods, Chinese features being very common. But I met many middle-aged, elderly and old, pure-blooded Marquesans, a fine, self-respecting race, commanding our admiration and pity. I can not believe that all these people, whom I saw in 1922 and 1923, will have vanished in 1930. It will take a longer time than that, perhaps only a few years longer, before the last pure-blooded Marquesan steps off the stage. I am quite sure that Dr. Linton,[1] of the Field Museum, and Dr. Handy, of Bishop Museum, Honolulu, both of whom have made a special study of the Marquesans, will agree with me in this.

But what is more to the point under discussion is that Mr. Wester evidently overlooks the fact that many of these pure bloods are leaving descendants, mixed bloods, to be sure, but just as much interested in the preservation of their ancient food, the breadfruit, as were their ancestors. Will not this fact tend to preserve these trees for a long time to come?

I found the breadfruit abundant on all the islands visited (fortunately, I was not obliged to eat poipoi) somewhat dwarfed when growing in the "jungle" in neglected valleys, but an enormous and noble tree when given space. The "jungle" of the Marquesas, by the way (although the islands are between 8 and 11 degrees south latitude) is by no means a tropical jungle as the latter is usually pictured, but is made up very largely of young and old and dying and dead specimens of the Fau, or Purao tree, a native hibiscus which grows to a large size, and is much used by the natives for building. One does not see, in the Marquesas, the rank, choking growths peculiar to Brazil, Central America and other really tropical countries. The appearance of the valleys in that group is more subtropical than tropical, and hence, while this growth may dwarf the breadfruit to a greater or less extent, it does not seem that it would always be fatal to its existence.

It is perhaps appropriate to describe briefly, in this connection, the agricultural conditions in Typee Vai, the valley on Nukuhiva made famous by Melville's classic "Typee." It will be remembered by those who have read his narrative that he escaped from his ship in Taiohae Bay in 1842 and was held a prisoner for many months by the cannibals of Typee. At that time he figured the inhabitants of the valley as represented by about 2,000 souls, with perhaps 2,000 more in the neighboring valley of Houmi. A period of 80 years has elapsed (not a long time historically) between his sojourn there and my visit in 1922. In November of that year I found 44 people in Typee, and 65 in Houmi, though from Pere Simeon Delmar, the charming and self-sacrificing priest at Taiohae, who is in close touch with all his people, I learned that the death rate in Typee had been normal for sev-

[1] Since writing the above I have received a letter from Dr. Linton in which he says: " . . . I certainly do not think that either the full-blooded Marquesans or the breadfruit are in immediate danger of extinction. The natives of Uapu and Uahuka are slightly on the increase and those of Fatuhiva are holding their own."

eral years and that one or two families there had many children.

I was astonished at the appearance of Typee Valley; for, from reading "White Shadows" and from Church's story, and from Mrs. Handy's article in the *Yale Review* for July, 1922, I expected to see a valley of desolation and ruin, with perhaps a dozen decrepit old people, green from long drinking of kava—worthless wretches in a huddle of huts on the shore. What I did see was an enormous valley, over a mile wide and ten miles long, beautifully green, with Melville's storied waterfall still showing as a silver thread amongst the verdure at the head of the valley. But the most astonishing revelations were the (few to be sure) large and luxuriant plantations of cocoanut palm, bananas and some breadfruit which checkered the lower part. As I stood on the ridge between Happar Valley and Typee and looked down into the latter, I was not only amazed at seeing evidence of comparative prosperity, though in a limited area, where I expected utter desolation, but I was deeply impressed with the agricultural possibilities of this historic region.

Finally, I believe the most significant factor in this matter of the preservation of breadfruit, both in the Marquesas and Society Islands, is the presence in the latter group of enormous and ever-increasing numbers of Chinese or half-Chinese who are as industrious and thrifty as the native is lazy and profligate. It looks as if they will very shortly own the islands in the eastern Pacific commercially. I will venture to say that in ten years Tahiti, picturesque and romantic for so long a time, will have lost its charm because of the presence of hordes of low-caste Chinese and half-bloods. However unattractive this may be from the standpoint of the tourist and sentimentalist, there is no contradicting the fact that they will make these islands a thousand times more productive than would the pure-blooded native, and their skill and habits of application will undoubtedly extend to the preservation of the breadfruit. The Chinese and half-blood Chinese are on all the Marquesan islands which are inhabited, and it will be to their financial interest as well as to the interest of their personal food supply, to preserve the breadfruit there as well as in the Societies.

It is notable that the cocoanut and banana plantations and papaye (papaw) groves in Typee at the time of my visit, were either owned or worked by Chinese or half-bloods (Chinese + Tahitian or Chinese + Marquesan).

Referring to the last paragraph in Mr. Wester's communication—It would appear that if one is dependent, as was the writer, upon trading schooners to get from Tahiti to the Marquesas, then amongst these islands and return to Tahiti, his program for work in these two groups would take more than a year and his estimate of expense might, in consequence, be exceeded. Sometimes one is obliged to wait from one month to three to get the opportunity to move from one island in the Marquesas to another forty or fifty or eighty miles away, so rare and uncertain are the visits of these schooners. Further, in the absence of any regular means of communication, one has to seize any chance opportunity of transportation or run the risk of being marooned for a long period. On the other hand, if a schooner were chartered, which is the best possible way of visiting and working among the South Sea Islands, schooner, captain, crew and provisions would cost about $1,000 per month (this figure was obtained from an authoritative source) and a year on shipboard might not be needed. Under such conditions Mr. Wester's calculation of $8,500 for a year's work in the Marquesas and Societies may not be far out of the way.

F. L. WASHBURN
UNIVERSITY OF MINNESOTA

WHAT IS A WEED?

PROFESSOR CAMPBELL'S comments upon this subject (July 20 issue, p. 50) are well put, but he undertakes to define what should be meant by the term rather than what is in common usage. Perhaps this word, like many others (botanist, for example), now does not serve its purpose as well as formerly. In that case it might be better to devise new terms rather than to modify the application of the old one. Such improvements are none too popular with either layman or scientist, but are adopted if well chosen and if such a need is apparent.

There are many plants commonly called "weeds" which do not fall within the proposed definition. Dodders and other parasitic seed plants have occupied such a prominent place in weed literature that it seems questionable whether they could be removed readily or whether placing them with parasitic fungi would be an improvement. Parasitic plants differ somewhat from independent ones in their habits, but is this not a minor difference? They still are in competition for food. We would make no distinction between a thief who steals flour and one who steals bread. Plants of rye in a wheat field, trees or bushes in or beside a field certainly are in active competition with the crop for food materials. If we do not think of fungi as weeds, is it not because of the invisibility of the plant body to the eye rather than their parasitic nature? One character commonly assigned to weeds is that they harbor fungus and insect pests. The writer has pointed out[1] that the common barberry is regarded as a weed, although it has no other attribute of the group.

[1] *Scientific Monthly*, August, 1923.

"Persistently obnoxious on cultivation areas" may cover the most common use of the term, but it does not cover the majority of species. It fails to account for two large groups: (1) Coarse unsightly plants, and (2) those of pastures, lawns, etc. Still other exceptions might be mentioned, water hyacinth, for instance. If these are not to be called weeds, we shall need some other name for them.

An attempt to arrange the different species of weeds in order of their importance shows an intergrading series which terminates indefinitely among such plants as goldenrods, wormwoods and numerous other native and introduced plants of minor importance. It would be no easier to decide which ones should be classed as persistently obnoxious than it is to locate the dividing line between weeds as commonly understood and other plants of less importance.

The writer's list of weeds of his state includes over twenty per cent. of the species of seed plants found in the state, and probably not over one third of them could be called persistently obnoxious on cultivated areas. Among the specimens received during a single season were fourteen species not included in this list and others are continually being added. Thus it appears that there are few wild plants which are not at least likely to be suspected of being weeds. The word seems to serve a purpose in common use and might be said to refer to a plant which is detrimental to man's interests, displeasing to the eye or of no evident value.

O. A. STEVENS

AGRICULTURAL COLLEGE,
NORTH DAKOTA

QUOTATIONS

THE NAPLES ZOOLOGICAL STATION

BIOLOGISTS all over the world will be interested in the news, of which we have just received official confirmation, that Dr. Reinhard Dohrn, the son of the founder of the Zoological Station at Naples, has once more taken up the post of director. As Dr. Dohrn is a German subject (although half-Russian by birth and Italian by upbringing), he was forced to leave Italy when it became clear that she was going to enter the war on the side of the Allies. During and since the war the Naples Station was under the Italian government and the Municipality of Naples, with Professor Monticelli, head of the Department of Zoology in the University of Naples, as director.

After the war a number of questions arose, and the legal status of the station under the peace-treaty was gone into at the instance of Dr. Dohrn. He claimed that it was for many reasons not liable to sequestration, while the Naples Municipality asserted it to have been private property, and therefore to have passed legally to them as landlords. These points and many others were decided in the courts, the case eventually going to the highest court of appeal. On all the essential counts Dr. Dohrn gained his point. Finally, government decrees were issued establishing the status of the station and defining its organization. Briefly, we may say that, while Dr. Dohrn goes back as director, the control is vested in a board of seven members, all except the director Italians; further, the heads of the separate departments of the station (at present two—zoological and physiological) are to be Italians. The position is therefore not the *status quo ante,* but this modified by a measure of Italian control and Italian share in the internal administration.

From being private property, the station has become a special form of public corporation known in Italy as an *ente morale.* The board is of seven members. The Mayor of Naples is *ipso facto* its president, while the other members are nominated quinquennially by the Minister of Public Instruction. The detailed direction and administration is reserved to Dr. Dohrn.

Plans for the future of the station will, of course, be determined by financial considerations. Several foreign governments and institutions have rented or have promised to rent "tables." The income under this head, however, will for the present not be so great as before the war. The income from the public aquarium is considerable, and grants are also to be made from the Naples Municipality and the Italian government. Finally, a certain amount of Dr. Dohrn's private property, which was sequestrated during the war, is to be applied to the use of the station. With these funds the new director hopes to be able to make an immediate start on a sound footing. He intends to appiont, besides the Italian *chefs de laboratoire,* several assistants of various nationalities on the staff.

* * * *

The Naples Station, we may be sure, will have as important results to its credit in the future as it has had in the past. Once alone in its field, it has become the parent, or at least the prototype, of a whole crop of similar institutions elsewhere. Many of these are now flourishing and well organized; and some, like Plymouth and Woods Hole, rival their original. Nevertheless, we sincerely hope that both financial support and a stream of biological workers will flow to the reorganized "Stazione" at Naples. In the past, as all who have worked within its precincts will testify, the full international spirit of scientific cooperation has always reigned. Under Dr. Dohrn we are sure that it will continue to do so in the future; and that spirit, in these difficult days, is worthy of all encouragement.—*Nature.*

SCIENTIFIC BOOKS

A Bibliography of Eugenics. By SAMUEL J. HOLMES, University of California Publications in Zoology, Vol. 25, pp. 1–514, $5.00.

A VOLUME of great value to workers in bionomics is Professor Holmes's "Bibliography of Eugenics." It often requires as much skill and a great deal more patience to compile a complete and workable record in any field of knowledge as to write a new contribution to science. Often the one is an outgrowth of the other. For in the preparation of his admirable recent survey of "The Trend of the Race," Dr. Holmes has naturally found it necessary to consider every memoir of importance and a good many others which had preceded his own summary. Hence the accumulation of titles which composes the present volume.

The classification of the multitude of books and papers (upwards of 13,000 in all) listed by him and the table of contents itself is informing as well as suggestive. The chief topics are: "Heredity and evolution," "Eugenics," "Genealogy," "Degeneracy," "Alleged increase of insanity," "Notorious families," "Heredity of defects," "Alcohol and heredity," "Venereal disease and heredity," "Heredity factor in crime," "Heredity factor in delinquency," "Inheritance of mental ability," "Genius and insanity," "Race," "Birth-rate," "Birth control," "Natural selection in man," "Selective effect of infant mortality," "Of war," "Sexual selection in man," "Urban selection," "Racial influence of religion," "Immigration and emigration," "Consanguinity," "Race mixture," "Determination of sex," "Sex ratio," "Influence of age of parents," "Order of birth," "Negative eugenics, segregation, sterilization," etc.

Dr. Holmes remarks that "it is a noteworthy circumstance that much of our knowledge of these topics has come from writers who were apparently unaware of the relation of their contributions to the problem of human evolution. . . . I have often been impressed with the enormous waste of effort which is attributable to a general lack of outlook upon racial problems. A large part of this literature might have been much more valuable had it been produced in the light of proper orientation and insight in regard to its wider bearings." In other words, a great deal that is well meant and much that rests on sheer ignorance or emotional prejudice is a burden on the work of the serious student. Most of the "writers on natural selection in man 'have apparently not had the subject of natural selection in mind at all.' . . . To talk . . . of natural selection as if it were practically done away with among civilized human beings, as many writers have done, is eminently absurd. In fact, it may be doubted if civilization has effected much diminution in the intensity with which natural selection acts on the human species."

DAVID STARR JORDAN

Principles of Advertising. By DANIEL STARCH. Chicago, A. W. Shaw Co., 1923, pp. 998.

THIRTY-SEVEN chapters, covering 998 pages, are required by Professor Starch in which to expound the principles of advertising. The main thesis of the work is that the principal function of advertising is to sell or help sell. Five main questions then appear: "(1) To whom may the product be sold? (2) By what appeals may it be sold? (3) How may the appeals be presented most effectively? (4) By what mediums may the appeals be presented so as to reach the class of people to whom the product is to be sold? (5) What is a reasonable expenditure for promoting the sale of the product by means of printed sales efforts?

The answers to these questions must come from the application of scientific method, and the author considers that his chief contribution lies in exposing this method so as to show its general applicability. It must be applied with the special technique of economics, sociology and especially psychology. Examples of all these methods of approach are given in profusion. The 165 tables in the book give such data as: "Figures covering sales, gross profits and advertising expenditures, eight retail stores"; "Proportion of wired homes by states"; "Selling points for a mint candy"; "How different sizes compare when used with the same frequency"; "Attention value of different sizes of display type"; "Tendency in the use of art forms in advertisements."

The book gives evidence of a vast amount of research, original research on the part of the author and his students and thorough culling of the literature on advertising so as to fulfill the aim of bringing together as fully as possible all available materials.

The section of six chapters dealing with the "Human aspects of the market" discusses methods of gathering general information about the consumer, through general statistical methods and through questionnaire. The section of six chapters on "Appeals" treats methods of testing marketing methods and individual advertisements. The sections on "Presentation of appeals" deals with suggestive advertising, argumentative advertising, headlines, illustrations, etc., in the conventional way. The section on "Mediums" discusses magazines, newspapers, posters, etc., in the customary way with as frequent citation as possible of factual material. There is a section entitled "Special fields of advertising" which treats national, retail, foreign and financial advertising.

If there is one characteristic which stands out more

clearly than another it is the compendiousness of the work. Hardly a question has arisen relative to advertising which is not referred to in the voluminous index. The answer is given if it can be truthfully stated. There are, however, many gaps in our knowledge, as Professor Starch would be only too willing to admit. And it is hoped that the excellent guidance which he has furnished in this book will stimultae workers in advertising to make the further investigations that are so greatly needed.

HARRY D. KITSON

LABORATORY APPARATUS AND METHODS

REMOVING JELLY FROM FROG OR TOAD EGGS

THE quantity of jelly surrounding the egg of the frog or toad is always a source of annoyance in laboratory study. The physical and chemical methods already in use are quite unsatisfactory and the writer has been trying for several years to find some process as free as possible from their defects. Professor C. I. Nelson, of the Department of Bacteriology of the North Dakota Agricultural College, suggested that "antiformin" as used in dissolving tuberculous sputum might be successful and it has proved wonderfully effective. It is inexpensive and sufficiently stable for a stock solution to last through the spawning period of the frog. For convenience the formula is given below.

Washing soda	2 pounds
Chloride of lime	1 pound
Water	1 gallon

Use the supernatant fluid from this mixture (or filter) and mix with equal parts of a 15 per cent. solution of sodium hydroxide. The egg masses in my experiments were first fixed in a 10 per cent. formalin solution.

100 to 125 cc is sufficient to dissolve the jelly on one clutch of eggs. The action is complete inside of ten minutes. The eggs are thoroughly washed in 8 or 10 changes of water and allowed to stand in water for a half hour or longer to remove any traces of the antiformin. The eggs are then passed through a series of alcohols to 70 per cent. where they are kept. After 12 or 24 hours they are slightly bleached to bring out the cleavage lines through the addition of a few drops of peroxide of hydrogen to each batch. If the eggs are subjected to bleaching before they have been hardened in alcohol there seems to be some tendency for disintegration. A few eggs tend to break up, but the majority remain in perfect condition. Three or four batches may be stored in an eight ounce bottle, whereas before the removal of the jelly a quart jar would be necessary to hold them.

ROBERT T. HANCE

UNIVERSITY OF PENNSYLVANIA

SPECIAL ARTICLES

CONDITIONS OF NATURAL SELECTION

OBJECTORS to natural selection seem only to have substituted variation or mutation for special creation and to hold that species were produced first and then dropped into the situations to which they were adapted. With them the origin of species is the same as that of distinctive characters. Species, it seems to me, are not dried things which may be separated by certain differences, but living things which occupy definite ecological positions, and that they separated first and got their differences afterwards.

Natural selection is an ecological theory. What it will account for must be ascertained by ecological investigation. Diversifications of food habits and of geographical and phenological ranges are its most important conditions.

Food habits.—One species of bee gets its pollen from flowers of one species, while another gets its pollen from those of another species. Two species are inquilines of different hosts. Of 182 local species of lower Aculeata whose flight is pretty well made out, 158 fly simultaneously, July 25-27. But for the fact that they provision their nests with different kinds of insects, so many species could hardly thrive in one place and fly at the same time.

Phenological range.—One species of bee flies in the spring, another in the fall. Of 296 local species, only 47.2 per cent. are flying simultaneously. Of 470 insect flowers, only 42.7 per cent. bloom at one time.

Geographical range.—It seems to be a general law that the most closely related species do not live in the same place. This is one of the most important facts in geographical distribution. In the case of 1,428 local species, mentioned in SCIENCE 48: 369, an average of only 1.7 belong to the same genus. The genera with more than one species are usually represented by the most divergent forms. The Bembicidae show only 10.4 per cent. of the North American species, but 83.3 per cent. of the genera. Of 79 families of insect flowers, compared with the same families given in Gray's Manual, 7th edition, the local flora shows 21.9 per cent. of the species and 44.1 per cent. of the genera. These estimates were suggested by the presumption that the most closely associated elements ought to be the most heterogeneous. The closer the competition is, the greater the generic diversification.

The early flora.—The composition of 159 species blooming before July and 162 blooming after June, shows the following percentages: